WHAT IS CLAIMED IS:

1. A magnetic sensor comprising:

a nonmagnetic metal layer including at least one element selected from the group consisting of Ru, Re, Os, Ti, Rh, Ir, Pd, Pt, and Al;

a pinned magnetic layer including first and second magnetic sublayers with a nonmagnetic interlayer disposed therebetween, the first magnetic sublayer in contact with the non-magnetic metal layer;

a free magnetic layer; and

a nonmagnetic conductive layer disposed between the pinned magnetic layer and the free magnetic layer, the first magnetic sublayer disposed farthest from the nonmagnetic conductive layer,

wherein crystals in the nonmagnetic metal layer and crystals in the first magnetic sublayer are oriented in an epitaxial or a heteroepitaxial state; and

an end face of the pinned magnetic layer is open and is configured to oppose a face of a recording medium.

2. The magnetic sensor according to claim 1,

wherein the nonmagnetic metal layer comprises at least one element selected from the group consisting of Rh, Ir, Pd, Pt, and Al; and

the nonmagnetic metal layer has a face-centered cubic (fcc) lattice structure in at least in the vicinity of a boundary adjacent to the first magnetic sublayer of the

pinned magnetic layer, and the nonmagnetic metal layer has an equivalent crystal plane represented by a {111} plane oriented in a direction parallel to the boundary.

3. The magnetic sensor according to claim 1,

wherein the nonmagnetic metal layer comprises at least one element selected from the group consisting of Ru, Re, Os, and Ti; and

the nonmagnetic metal layer has a hexagonal close-packed (hcp) structure at least in the vicinity of a boundary adjacent to the first magnetic sublayer of the pinned magnetic layer, and the nonmagnetic metal layer has a C-plane ({0001} plane) oriented in a direction parallel to the boundary.

4. The magnetic sensor according to claim 1, further comprising:

bias layers to supply the free magnetic layer with a longitudinal bias magnetic field, the bias layers being disposed at side ends of the free magnetic layer and the pinned magnetic layer.

5. The magnetic sensor according to claim 1, wherein the first magnetic sublayer of the pinned magnetic layer has a face-centered cubic (fcc) lattice structure at least in the vicinity of a boundary adjacent to the nonmagnetic metal layer, and the first magnetic sublayer has an equivalent crystal plane represented by a {111} plane oriented in a

direction parallel to the boundary.

6. The magnetic sensor according to claim 5, wherein the first magnetic sublayer of the pinned magnetic layer comprises Co or Co_xFe_y (in which about 20≥y, x+y= about 100, and x and y are atomic percent).

7. The magnetic sensor according to claim 1, wherein the first magnetic sublayer of the pinned magnetic layer has a body-centered cubic (bcc) lattice structure in at least the vicinity of a boundary adjacent to the nonmagnetic metal layer, and the first magnetic sublayer has an equivalent crystal plane represented by a {110} plane oriented in a direction parallel to the boundary.

8. The magnetic sensor according to claim 7, wherein the first magnetic sublayer of the pinned magnetic layer comprises Co_xFe_y (in which y≥ about 20, x+y= about 100, and x and y are atomic percent).

9. The magnetic sensor according to claim 1,

wherein the first magnetic sublayer of the pinned magnetic layer has a face-centered cubic (fcc) lattice structure in the vicinity of the first boundary adjacent to the nonmagnetic metal layer, and the first magnetic sublayer has an equivalent crystal plane represented by a {111} plane oriented in a direction parallel to the first boundary; and

the first magnetic sublayer of the pinned magnetic layer

has a body-centered cubic (bcc) lattice structure in the vicinity of a second boundary adjacent to the nonmagnetic interlayer, and the first magnetic sublayer has an equivalent crystal plane represented by the {110} plane oriented in a direction parallel to the second boundary.

10. The magnetic sensor according to claim 9,

wherein the first magnetic sublayer of the pinned magnetic layer comprises, in the vicinity of the first boundary: Co_xFe_y (in which about 20≥y, x+y= about 100, x and y are atomic percent) or Co; and

the first magnetic sublayer of the pinned magnetic layer comprises Co_xFe_y (in which y≥ about 20, x+y= about 100, x and y are atomic percent) in the vicinity of the second boundary.

11. The magnetic sensor according to claim 10, wherein the first magnetic sublayer contains Fe, and an Fe content gradually increases from the first boundary to the second boundary.

12. The magnetic sensor according to claim 1, wherein a difference between a nearest interatomic distance of the nonmagnetic metal layer in a plane parallel to a boundary between the nonmagnetic metal layer and the first magnetic sublayer and a nearest interatomic distance of the first magnetic sublayer of the pinned magnetic layer in the plane parallel to the boundary divided by the nearest interatomic distance of the first magnetic sublayer is in the range of

about 0.05 to 0.20.

13. The magnetic sensor according to claim 1, further comprising:

an interlayer disposed between the nonmagnetic metal layer and the first magnetic sublayer of the pinned magnetic layer, the interlayer comprising a PtMn alloy or X-Mn alloy (wherein X is at least one element selected from the group consisting of Pd, Ir, Rh, Ru, Os, Ni, and Fe).

14. The magnetic sensor according to claim 13,

wherein the crystals in the nonmagnetic metal layer and crystals in the interlayer are oriented in an epitaxial state; and

the crystals in the interlayer and crystals in the pinned magnetic layer are oriented in an epitaxial or a heteroepitaxial state.

15. The magnetic sensor according to claim 1, wherein the first magnetic sublayer comprises a magnetic material having a positive magnetostriction constant.

16. The magnetic sensor according to claim 1, further comprising:

electrode layers disposed at sides of the free magnetic layer, the nonmagnetic conductive layer, and the pinned magnetic layer, the electrode layers containing Cr, α-Ta, or Rh.

17. The magnetic sensor according to claim 16, wherein:

if the electrode layers comprise Cr, which has a bcc structure, a distance between {110} crystal planes of the electrode layers in a direction parallel to the layers is at least about 0.2044 nm;

if the electrode layers comprise α-Ta, which has a bcc structure, the distance between {110} crystal planes of the electrode layers in a direction parallel to the layers is at least about 0.2337 nm; and

if the electrode layers comprise Rh, which has an fcc structure, the distance between {111} crystal planes of the electrode layers in the direction parallel to the layers is at least about 0.2200 nm.

18. The magnetic sensor according to claim 1, wherein an optical track width of the pinned magnetic layer is at most about 0.15 μm.

19. The magnetic sensor according to claim 1, wherein the nonmagnetic metal layer has one of:

a face-centered cubic (fcc) lattice structure throughout the nonmagnetic metal layer and has an equivalent crystal plane represented by a {111} plane oriented in a direction parallel to a boundary between the nonmagnetic metal layer and the first magnetic sublayer; and

a hexagonal close-packed (hcp) structure throughout the nonmagnetic metal layer and has a C-plane ({0001} plane)

oriented in the direction parallel to the boundary.

20. The magnetic sensor according to claim 1, wherein the first magnetic sublayer has one of:

a face-centered cubic (fcc) lattice structure throughout the first magnetic sublayer and has an equivalent crystal plane represented by a {111} plane oriented in a direction parallel to a boundary between the nonmagnetic metal layer and the first magnetic sublayer; and

a body-centered cubic (bcc) lattice structure throughout the first magnetic sublayer and has an equivalent crystal plane represented by a {110} plane oriented in the direction parallel to the boundary.

21. The magnetic sensor according to claim 13, wherein a thickness of the interlayer is between about 5 Å and 50 Å.

22. The magnetic sensor according to claim 1, further comprising a seed layer containing NiFe alloy, NiFeCr alloy, Cr, or Ta and having a thickness of about 35 Å to 60 Å and on which the nonmagnetic metal layer, the pinned magnetic layer, the free magnetic layer, and the nonmagnetic conductive layer are disposed.

23. The magnetic sensor according to claim 1, wherein at least one of the first and second magnetic sublayers comprise a plurality of sublayers, the plurality of sublayers including a bcc magnetic sublayer provided at a

non-magnetic interlayer side and, if the first magnetic layer contains the plurality of sublayers, an fcc magnetic sublayer provided at a non-magnetic metal layer side, or if the second magnetic layer contains the plurality of sublayers, an fcc magnetic sublayer provided at a non-magnetic material layer side.

24. A magnetic sensor comprising:

a nonmagnetic metal layer;

a pinned magnetic layer including first and second magnetic sublayers with a nonmagnetic interlayer disposed therebetween, the first magnetic sublayer in contact with the non-magnetic metal layer;

a free magnetic layer; and

a nonmagnetic conductive layer disposed between the pinned magnetic layer and the free magnetic layer, the first magnetic sublayer disposed farthest from the nonmagnetic conductive layer,

wherein the nonmagnetic metal layer and the first magnetic sublayer have crystalline lattices in which a difference between a nearest interatomic distance of the nonmagnetic metal layer in a plane parallel to a first boundary between the nonmagnetic metal layer and the first magnetic sublayer and a nearest interatomic distance of the first magnetic sublayer of the pinned magnetic layer in the plane parallel to the first boundary divided by the nearest interatomic distance of the first magnetic sublayer is in the range of about 0.05 to 0.20, and

an end face of the pinned magnetic layer is open and is configured to oppose a face of a recording medium.

25. The magnetic sensor according to claim 24, wherein the nonmagnetic metal layer has a thickness of about 5 Å to 30 Å, the first magnetic sublayer has a thickness of about 10 Å to 30 Å, and the second magnetic sublayer has a thickness of about 15 Å to 35 Å.

26. The magnetic sensor according to claim 24, wherein the nonmagnetic metal layer and the first magnetic sublayer have the same type of crystalline lattice at the first boundary.

27. The magnetic sensor according to claim 26, wherein the type of crystalline lattice of at least one of the nonmagnetic metal layer and the first magnetic sublayer remains the same throughout the at least one of the nonmagnetic metal layer and the first magnetic sublayer.

28. The magnetic sensor according to claim 24, wherein the nonmagnetic metal layer and the first magnetic sublayer have different types of crystalline lattices at the first boundary.

29. The magnetic sensor according to claim 28, wherein the type of crystalline lattice of at least one of the nonmagnetic metal layer and the first magnetic sublayer

remains the same throughout the at least one of the nonmagnetic metal layer and the first magnetic sublayer.

30. The magnetic sensor according to claim 24, wherein the composition of the first magnetic sublayer gradually changes between the first boundary to a second boundary between the first magnetic sublayer and the nonmagnetic interlayer.

31. The magnetic sensor according to claim 24, wherein the first magnetic sublayer comprises a magnetic material having a positive magnetostriction constant.

32. The magnetic sensor according to claim 24, further comprising bias layers to supply the free magnetic layer with a longitudinal bias magnetic field, the bias layers being disposed at side ends of the free magnetic layer and the pinned magnetic layer, a thickness t of the bias layers being about 200 Å$\geq$ t $\geq$100 Å.

33. The magnetic sensor according to claim 24, wherein a magnetostriction constant λ of the free magnetic layer is about $-0.5\times10^{-6}\geq \lambda \geq -8\times10^{-6}$.

34. The magnetic sensor according to claim 24, wherein the nonmagnetic metal layer comprises at least one element selected from the group consisting of Ru, Re, Os, Ti, Rh, Ir, Pd, Pt, and Al, and the first magnetic sublayer comprises Co

or an CoFe alloy.

35. The magnetic sensor according to claim 34, wherein an Fe content of the first magnetic sublayer gradually increases from a maximum of about 20 at% at the first boundary to a minimum of about 20 at% at a second boundary between the first magnetic sublayer and the nonmagnetic interlayer.

36. The magnetic sensor according to claim 24, wherein an optical track width of the pinned magnetic layer is at most about 0.15 μm.

37. The magnetic sensor according to claim 24, wherein a thickness of the interlayer is between about 5 Å and 50 Å.

38. The magnetic sensor according to claim 24, further comprising a seed layer containing NiFe alloy, NiFeCr alloy, Cr, or Ta and having a thickness of about 35 Å to 60 Å and on which the nonmagnetic metal layer, the pinned magnetic layer, the free magnetic layer, and the nonmagnetic conductive layer are disposed.

39. The magnetic sensor according to claim 24, wherein at least one of the first and second magnetic sublayers comprise a plurality of sublayers, the plurality of sublayers including a bcc magnetic sublayer provided at a non-magnetic interlayer side and, if the first magnetic

layer contains the plurality of sublayers, an fcc magnetic sublayer provided at a non-magnetic metal layer side, or if the second magnetic layer contains the plurality of sublayers, an fcc magnetic sublayer provided at a non-magnetic material layer side.

40. A method of forming a magnetic sensor, the method comprising:

providing a nonmagnetic metal layer including at least one element selected from the group consisting of Ru, Re, Os, Ti, Rh, Ir, Pd, Pt, and Al;

forming a pinned magnetic layer including first and second magnetic sublayers with a nonmagnetic interlayer disposed therebetween such that the first magnetic sublayer is in contact with the non-magnetic metal layer and crystals in the nonmagnetic metal layer and crystals in the first magnetic sublayer are oriented in an epitaxial or a heteroepitaxial state;

forming a free magnetic layer;

forming a nonmagnetic conductive layer disposed between the pinned magnetic layer and the free magnetic layer such that the first magnetic sublayer is disposed farthest from the nonmagnetic conductive layer; and

opening an end face of the pinned magnetic layer, the end face being configured to oppose a face of a recording medium.

41. The method according to claim 40, wherein a

temperature of a substrate on which the pinned magnetic layer and the nonmagnetic metal layer are formed is higher during deposition of the first magnetic sublayer than during deposition of the nonmagnetic metal layer.

42. The method according to claim 40, further comprising annealing the nonmagnetic metal layer, the pinned magnetic layer, the free magnetic layer, and the nonmagnetic conductive layer at at least about 290°C for at least about four hours.

43. The method according to claim 40, further comprising varying the composition of the first magnetic sublayer such that the composition gradually changes between a first boundary between the nonmagnetic metal layer and the first magnetic sublayer and a second boundary between the first magnetic sublayer and the nonmagnetic interlayer.

44. The method according to claim 43, further comprising gradually increasing an amount of Fe in the first magnetic sublayer contains Fe from the first boundary to the second boundary.

45. The method according to claim 44, wherein the first magnetic sublayer of the pinned magnetic layer comprises:

in the vicinity of the first boundary Co_xFe_y (in which about $20 \geq y$, $x+y=$ about 100, x and y are atomic percent) or Co; and

in the vicinity of the second boundary Co_xFe_y (in which $y \geq$ about 20, $x+y=$ about 100, x and y are atomic percent).

46. The method according to claim 40, further comprising forming the nonmagnetic metal layer and the first magnetic sublayer such that a difference between a nearest interatomic distance of the nonmagnetic metal layer in a plane parallel to a boundary between the nonmagnetic metal layer and the first magnetic sublayer and a nearest interatomic distance of the first magnetic sublayer of the pinned magnetic layer in the plane parallel to the boundary divided by the nearest interatomic distance of the first magnetic sublayer is in the range of about 0.05 to 0.20.

47. The method according to claim 40, further comprising forming an interlayer between the nonmagnetic metal layer and the first magnetic sublayer of the pinned magnetic layer, the interlayer comprising a PtMn alloy or X-Mn alloy (wherein X is at least one element selected from the group consisting of Pd, Ir, Rh, Ru, Os, Ni, and Fe).

48. The method according to claim 47, further comprising forming the nonmagnetic metal layer, the pinned magnetic layer, and the interlayer such that the crystals in the nonmagnetic metal layer and crystals in the interlayer are oriented in an epitaxial state and the crystals in the interlayer and crystals in the pinned magnetic layer are oriented in an epitaxial or a heteroepitaxial state.

49. The method according to claim 40, further comprising limiting an optical track width of the pinned magnetic layer to at most about 0.15 μm.

50. The method according to claim 40, further comprising limiting a thickness of the interlayer to between about 5 Å and 50 Å.

51. The method according to claim 40, further comprising applying a uniaxial stress to the pinned magnetic layer in a height direction during deposition or in a heat treatment after deposition, to orient polycrystals that form the first magnetic sublayer into a uniaxis.

52. The method according to claim 51, further comprising applying a magnetic field to the pinned magnetic layer in a height direction during deposition or subsequent heat treatment of the pinned magnetic layer.